Two *ballons-sondes*, one of paper the other of silk, carrying self-recording instruments, were sent up at 3 a. m. and 8:35 a. m., respectively. They traveled in a south-southwest direction, but not very far, reaching a maximum height of about 8,000 meters. The "Girbaden" left the ground in a light rain at 9:05 a. m., rose through two strata of clouds to a height exceeding 4,000 meters and after a voyage of a little more than three hours a sudden descent, to escape a threatenstorm, landed us in the Vosges Mountains, near the town of Ammerschweid, a few kilometers northwest of Colmar and about 75 kilometers south-southwest of Strasburg. The observations of temperature and humidity were made every few minutes by Professor Hergesell with an Assmann aspiration psychrometer, hung outside the basket of the balloon and several feet distant therefrom, but drawn near to it for reading, and when it was necessary, to wet the bulb of the thermometer. Simultaneous observations of pressure were made by the writer with a large aneroid barometer, of which the corrections were determined under an air pump previous to and subsequent to the ascension. A portable barograph, belonging to the writer, registered continuously the approximate heights and showed at every moment whether the balloon was rising or falling. The detailed observations follow:

Ascent of "Girbaden" (1,300 cubic meters of coal gas) from Strasburg, July 4, 1901, with Prof. H. Hergesell and A. L. Rotch.

Time. A. M.	Bar. (cor'd)	Height above sea.	Aspiration thermometers.		Vapor press.	Dew-point.	Rel. hum.	Remarks.
			Dry.	Wet.				
H. m.	*Mm.*	*M.*	*° C.*	*° C.*	*Mm.*	*° C.*	*%.*	
....	756.5	0	16.5?	....	....	....	....	
9 05	....	143	15.4	15.4	13.00	15.4	100	Rose from Steinthor; light rain.
08	709.7	525	12.7	....	....	....	....	Moving south over Strasburg.
10	702.3	630	12.0	....	....	....	....	In clouds.
12	695.8	720	11.4	11.4	10.08	11.4	100	Clouds thinner
16	690.6	775	11.2	11.2	9.90	11.2	100	Four sacks of ballast thrown out.
17	685.3	830	10.9	10.9	9.70	10.9	100	
20	679.0	925	10.4	10.4	9.39	10.4	100	Clouds very thin. Insolation felt.
22	672.8	1000	....	....	....	....	....	Sun appears; we are on upper edge of cloud.
24	668.6	1055	10.3	10.1	9.11	10.0	98	Below us is a sea of clouds; above is a broken cloud sheet, presumably alto-stratus.
27	660.8	1155	9.5	9.0	8.33	8.6	94	
30	....	....	....	....	....	....	....	In north-northwest in neighborhood of Vosges Mountains are turretted cumulus.
32	....	....	....	....	....	....	....	One-quarter sack ballast out
33	641.4	1395	8.2	7.8	7.71	7.5	95	Cloud sea broken, permitting fields and a village to be seen below.
35	....	....	....	....	....	....	....	Three-quarter sack ballast out. We are going parallel with the railway to Basel.
36	632.3	1500	7.5	7.1	7.85	6.8	95	
42	618.7	1690	6.8	6.4	7.00	6.1	95	
43	610.1	1800	5.9	5.4	6.49	5.0	94	One sack ballast out.
54	598.0	1975	4.8	?	....	....	....	
56	....	....	....	....	....	....	....	We decide to traverse upper cloud stratum, and throw out one sack ballast.
58	586.5	2150	5.0	3.0	4.88	0.9	75	
10 00	583.5	2190	3.7	2.2	4.76	0.6	81	Cumulus below; the cloud stratum above has become dense stratus.
02	....	....	....	....	....	....	....	One sack ballast out.
06	575.4	2250	3.0	2.9	5.58	2.8	99	Balloon follows exactly the bed of the Ill.
08	....	....	....	....	....	....	....	One sack ballast out.
11½	561.4	2480	2.3	2.0	5.16	1.7	96	We enter upper cloud.
14	....	....	....	....	....	....	....	One sack ballast out.
15	555.4	2565	1.4	1.4	5.05	1.4	100	In clouds; sun faintly seen.
16½	545.4	2715	0.9	0.8	4.80	0.7	99	Upper limit of cloud.
18½	540.4	2785	0.1	−0.4	4.26	−1.0	92	Thermometer of aneroid in sun +19°. Above us is clear, deep-blue sky; beneath us unbroken sea of clouds; in southwest high cumulus summits (cumulo-nimbus) with cirrus.
29	515.1	3150	−2.1	−2.8	3.48	−3.7	89	
34	508.5	3260	−3.8	−4.2	3.22	−4.8	93	
38	506.9	3295	−3.6	−4.2	3.16	−5.0	90	
41	500.8	3400	−3.7	−4.2	3.19	−4.9	91	
45	....	....	....	....	....	....	....	One sack ballast out
47	490.5	3560	−4.0	−4.2?	....	....	....	Wet bulb probably not in order.
50	484.3	3660	−4.0	....	....	....	....	
11 04	475.6	3805	−4.7	−5.7	2.68	−7.2	83	
11½	462.6	4060	....	....	....	....	....	
13	462.1	4067	−7.6	−9.2	1.79	−12.3	69	
16	....	....	....	....	....	....	....	One sack of ballast out.
21	457.9	4120	−7.3	−10.5	1.09	−18.3	41	
23½	455.3	4160	−6.7	−9.4	1.43	−15.1	51	
25½	454.6	4170	−6.8	−10.2	1.08	−18.4	41	Maximum height. Temperature measured several times.
27	458.7	4110	−6.8	−9.7	1.31	−16.1	48	
36	458.7	4110	−6.4	−9.3	1.38	−15.5	48	
P. M.								The great cumulo-nimbus clouds approach nearer and nearer, and the gray masses can be seen boiling up. Since there is danger of being drawn into a thundercloud we decide to descend at once. Repeated pulls of the valve cause the balloon to fall rapidly, and in five minutes it reaches the upper cloud stratum and descends quickly through it. Between the two cloud strata there is some sunlight. We sink into the lower cloud that reaches low down and only discover, when near the ground, that we are above the forests of the Vosges Mountains. The balloon rapidly traverses a town, later found to be Kaisersberg. With the drag rope touching the ground we cross the spur of a mountain, between Kaisersberg and Ammerschweir, and land at 12h. 18m. in scrub wood two kilometers from Ammerschweir. Immediately after landing there was a squall, with heavy rain.
12 23	725.0	365	16.0	14.6	11.67	13.7	86	Cumulo-nimbus moving from north-northeast, with rain in mountains.

DIURNAL WINDS ON FAINT GRADIENT IN NORTHWESTERN NEW MEXICO.

By Prof. Richard E. Dodge, of Columbia University, New York.

The diurnal winds that have been observed during the last three summers in northwestern New Mexico deserve note because of the gentle gradient along which they move. The winds in question occur regularly in the canyon of the Chaco River, one of the southern tributaries of the San Juan River, which is in turn a tributary of the Colorado River. The valley has an east-west extent for nearly ten miles, and it is in this stretch that the winds have been observed, the observer having his station in the middle of the stretch at Pueblo Bonito, now the post office at Putnam, N. Mex.

The valley throughout the stretch in question is a little more than one-half mile in width, and is bordered by mesas averaging 250 feet in height. The north mesa rises nearly vertically for 100 feet, but the south mesa has a gently sloping shale slope at its base that is approximately 50 feet in height. The gradient of the valley in the stretch noted is a little less than ten feet to the mile.

The west wind sets in between 9:30 and 10:30 a. m., and usually about 10 a. m. It may first be noted as a gentle breeze just stirring a flag. The wind increases slightly in intensity as the day advances, reaching a maximum in the early afternoon. After midday local overturnings forming large dust whirls may frequently be observed. From 4 to 7 p. m. the wind usually decreases in intensity, and a dead calm for a half hour, or an hour, may succeed the breeze. Between 8:30 and 10:30 p. m., and usually between 9 and 9:30, p. m., the breeze begins from the east, being at first but a quiet movement, just observable to the moistened finger. The breeze increases as the night advances, and usually reaches a maximum about 4 a. m. From that hour until the west wind sets in, the movement decreases and there may be a calm.

The wind has been observed during July, August, and September, but it is of more frequent occurrence in the dry season, which this year ended on July 21. From July 9 to July 21, 1901, the wind change occurred daily, with the exception of three days, during the passage of a slight low pressure area. During the remainder of July and the first part of August rains occurred almost daily, and the normal winds were disturbed, especially in the daytime. The night wind occurred on nearly every fair night, but the day wind frequently blew from the south or southwest rather than west, and usually changed to east before a shower.

Mountain and valley breezes are frequent in the mountain valleys of steep grade in the Western States, and, as noted by Mill (Realm of Nature, p. 128), campers and cowboys build their fires so as to have them to leeward of camp when the wind sets in; but it is believed that mountain and valley breezes on such a faint gradient as that noted above have not been often recognized and described.

ORIGINAL MEMOIRS ON THE GENERAL CIRCULATION OF THE ATMOSPHERE.[1]

Compiled and annotated by MARCEL BRILLOUIN, Paris, 1900. Historical introduction translated by the Editor.

INTRODUCTION.

Ever since the first expedition of Christopher Columbus, navigators have known that permanent east winds prevail on both sides of the equator. Emanating from near the Tropics, these winds move first toward the equator and turn more and more toward the west. A rainy zone of equatorial calms separates the two belts of trade winds. Beyond the trade winds and nearer to the poles the west winds blow with much less regularity. Sailing vessels make use of these west winds for the return voyage from America to Europe in the same way that they have utilized the trades to go from Europe to America. Such are the facts as they were generally known when, in 1686, there appeared in the Philosophical Transactions of London a memoir by the astronomer Halley, who had himself sailed through the Tropics and collected numerous observations on the trade winds and the monsoons. In place of the ridiculous explanations which had appeared in the preceding years in these Transactions, Edmund Halley introduced the expansion of the atmosphere under the influence of solar radiation. The air should flow downward toward the warmest point, expand under the action of the sun, and, rising again, spread itself out in every direction. But this, which explains the movement of the air from the poles toward the equator, would require west winds in the morning alternating with east winds in the evening, instead of permanent east winds. It was not the trade winds, but only their diurnal variations, that were explained by Halley; it was a play on words that attributed to the progress of the maximum temperature from east to west, in the train of the sun, the power to carry the movement of the air along in the same direction. In these ideas the apparent motion of the sun was alone considered; the true rotation of the earth had no rôle attributed to it.

Nearly fifty years passed by before, in 1735, this latter influence was recognized by another English astronomer, George Hadley (the brother of John Hadley, the inventor of the sextant), in a memoir entitled: "Concerning the cause of the general trade winds." The air coming from the temperate regions toward the warm equatorial zone arrives at parallels which are farther and farther from the earth's axis of rotation, and whose linear velocity from west to east is greater and greater; the air therefore remains behind. This retardation is really much less than the 87 miles an hour that the change of latitude from the Tropics to the equator would seem to indicate, because all along its course the air is partially carried forward by the surface of the earth over which it flows. Moreover,

> * * * the northeast and southeast winds which prevail between the Tropics must be compensated somewhere by northwest and southwest winds, and generally the winds from any quadrant whatever must be compensated by opposite winds elsewhere; unless this were the case the rotation of the earth on its axis would not be maintained.

The air that has risen above the equatorial zone has maintained a velocity from west to east nearly equal to that of the equator itself; it overflows above the air of the trade winds, redescends toward the poles and appears beyond the Tropics as a west wind; but Hadley does not explain the meridional component of these west winds. Although the influence of the motion of the earth is not correctly estimated, yet this memoir is fundamental; it remained, however, unknown for nearly a century.

Hurricanes or cyclones alone attracted the attention of meteorologists during the first half of the nineteenth century. Nevertheless, in 1825, Leopold de Buch expressed the opinion that the counter trade winds descend to the surface of the earth toward the Tropics, and flow toward the poles; but if this be the case, how is the circuit completed, and how are the trade winds fed? He does not even ask himself these questions.

In 1855, in the Physical Geography of the Ocean, Maury gave the first Schematic chart showing the circulation of the air on a uniform earth. Maury assumed, without, however, giving reasons satisfactory even to himself, a singular intercrossing of currents at the poles, the Tropics, and the equator.

The following year, 1856, his compatriot, Ferrel, at Nashville, Tenn., not being satisfied with Maury's book, published in an American medical journal, an entirely different drawing. According to him the atmosphere is subdivided into six zones of independent circulation, separated by belts of motion alternately ascending at the equator and along the polar circles, and descending along the Tropics and at the poles. A minimum pressure prevails at the equator and in the polar regions; a maximum pressure prevails on the twenty-eighth degree of latitude.

This memoir by Ferrel was soon followed by a purely mathematical memoir on the motion relative to the surface of the globe. The equations adopted in this memoir are the strict equations of relative motion; the centrifugal accelerations are introduced into it in a natural and complete manner as a consequence of the passage from fixed coordinates to coordinates moving with the earth. Ferrel showed the

[1] Professor Marcel Brillouin, of Paris, has lately published a French translation or summary of a number of important meteorological memoirs under the general title of Mémoires Originaux sur la Circulation Générale de l'Atmosphère. He has enriched this volume with numerous notes—historical, explanatory, and critical—so that it forms an important and convenient introduction to the study of the hydrodynamic problems that are presented by the earth's atmosphere. It is also the best introduction to Brillouin's famous memoir of 1898, entitled Vents contigus et Nuages. The introduction to this volume consists of an interesting historical memoir by Brillouin, which we take the liberty of publishing in full in the accompanying translation, believing that the readers of the MONTHLY WEATHER REVIEW will profit by Brillouin's criticisms and will not be misled by one or two passages, in which he gives the views of de Tastes as to the importance of the Gulf Stream and the Kuroshiwo rather more prominence than would seem necessary in the present state of our knowledge.